



THE COMMERCIAL PATH FORWARD FOR CSP TECHNOLOGIES



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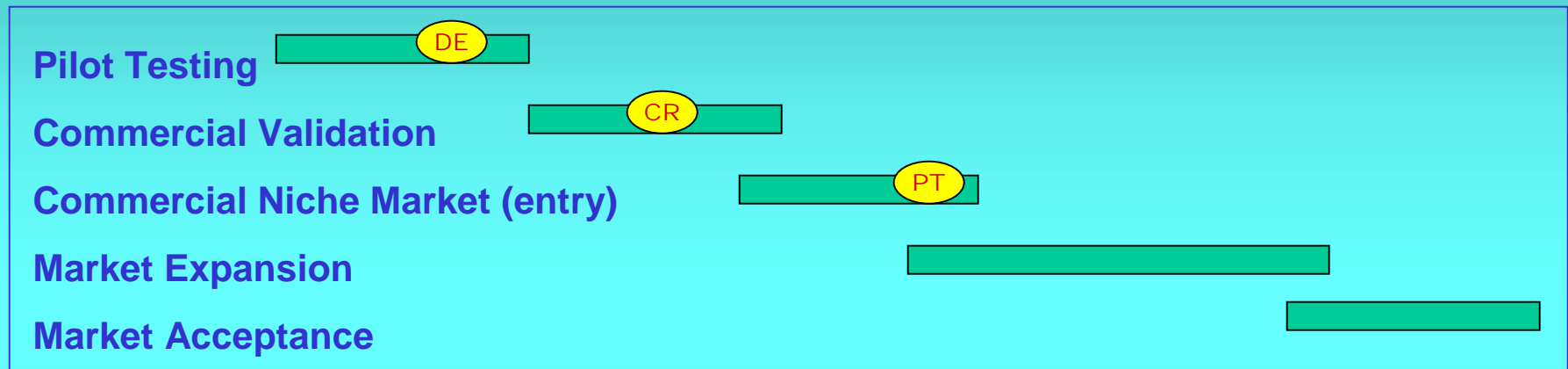
MARKET STATUS AND POTENTIAL

CSP is, or is close to, commercial/entry market, with the potential market large enough to justify needed subsidies.

Market expansion and market acceptance lie ahead for all CSP technologies, with troughs closer to that stage. Structured programs, with subsidies and policies, are needed to move CSP technologies into the main market.

MARKET STATUS

The commercialization path may be described in five phases:



Conclusion – Market expansion and market acceptance lie ahead for all CSP technologies, with troughs closer to that stage. Structured programs are needed to move CSP technologies through these last three phases.

Market Projections

Estimates for installed capacity range widely from:

1,800 – 8,300 MW by 2010

20,000 – 45,000 MW by 2020

Today's capacity is 354 MW of commercial PT power.

Conclusion – The market potential for CSP appears to be large and worth the effort required to access it. A rigorous assessment of the global potential of each CSP technology is needed.

TAKE-OFF COSTS AND CAPACITIES

MARKET TAKE-OFF PRICES Solar Thermal Power Technologies

Technology	Market Application	Take-off Prices
Dish	Grid-connected sub-station	5 – 10 ¢/kWh
	Distributed Generation	6 – 12 ¢/kWh
	Rural Generation – Diesel	12 – 30 ¢/kWh
Tower	Central Station – Intermediate	4 – 6 ¢/kWh
	Central Station – Peaking	6 – 8 ¢/kWh
Trough	Central Station – Intermediate	4 – 6 ¢/kWh
	Central Station – Peaking	6 – 8 ¢/kWh

CSP INSTALLED CAPACITY REQUIRED TO REACH TOP

Given supportive subsidies and policies, estimates are:

- **Dish** 0.1 MW pilot systems today. Will require several 10 MW size plants, perhaps several hundred MWs, to reach TOP.
- **Tower** 10 MW validation systems today. Solar Tres will be 15 MW and will need to be followed by one or two GEF plants in the 30-40 MW size, then followed by many more in the 100 – 200 MW size for 1-2 thousand MWs
- **Trough** 354 MW today. Need about 5-10 more in the 100 – 200 MW size, perhaps a total of 1-2 thousand MWs.

Caution – Installed capacity to reach TOP is very difficult to estimate due to its complex dependencies.

COST REDUCTION POTENTIAL

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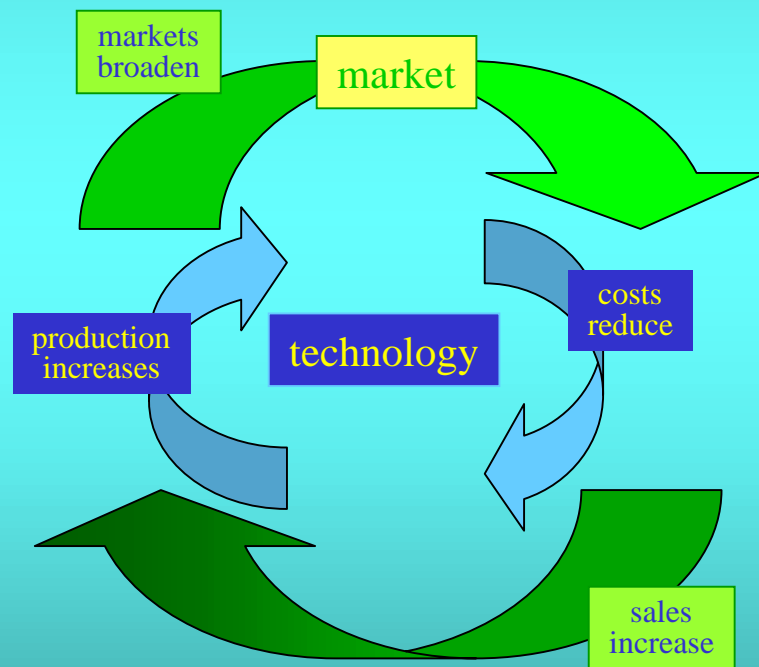
The three CSP technologies can reach their take-off price points in next five years with a relatively small number of projects, further technology development and subsidies.

Electricity costs – must reduce capital costs via technology and project learning curve improvements and reduce debt service via better financing and subsidies and reduced risk.

- Dish/Engine Manufacturing scale-up to 1,000 units/yr required
- Trough/Tower Many available options identified to reach take-off costs

With incentives, the necessary “virtuous cycles” of production scale-up – cost reduction – increased market share are feasible and could be rapidly established for all CSP technologies.

The Virtuous Cycle



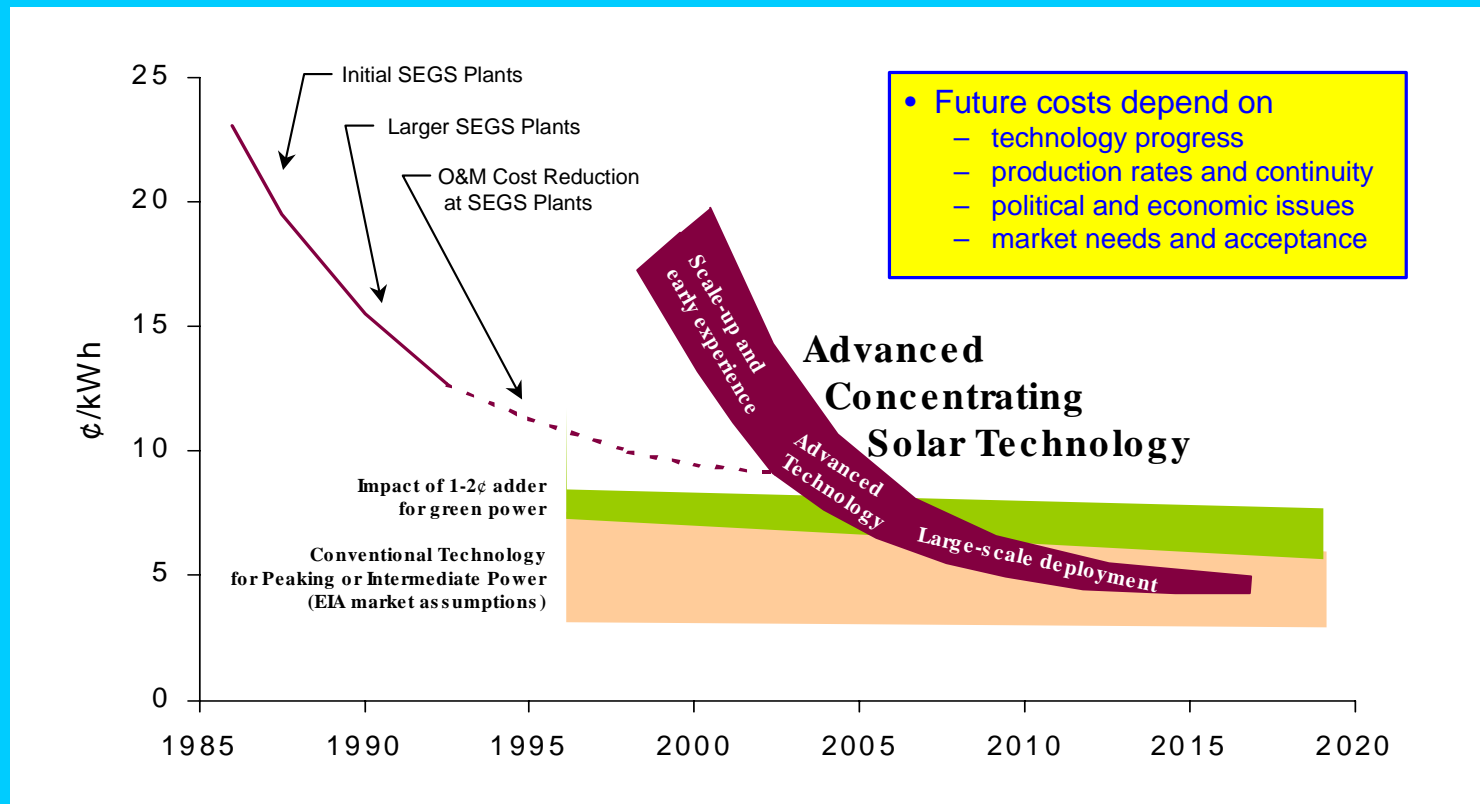
Market opportunities lead to increased production, lowering costs. Sales increase, leading to further rises in production and opening up new market horizons.

CR/PT COST REDUCTION POTENTIAL

- To reach take-off prices must reduce capital costs and debt service costs.
- Capital costs can be reduced by manufacturing scale-up, technology improvements, clustering, cycle changes and larger plant sizes.
- Debt service costs can be reduced by grants, low interest loans and tax credits.
- The California plants have demonstrated a significant cost reduction due to investor cost reductions, O&M cost reductions and significant technology improvements

Conclusion – Build more and larger plants with improved technology and lower debt service.

The CSP Learning Curve 1985-2015

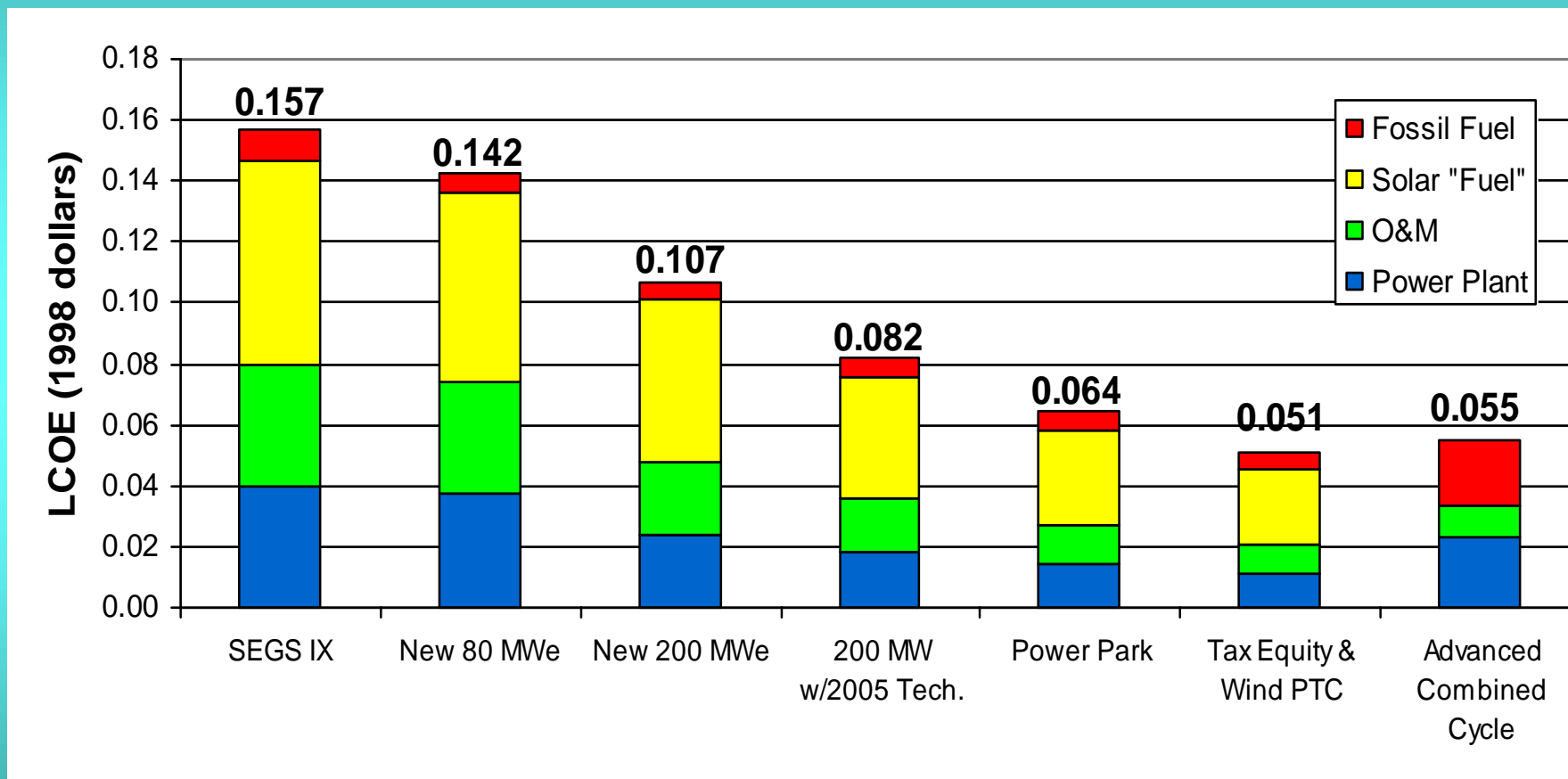


Source: Solar Paces (Geyer)

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12

Cost Reduction Impacts on Trough Plant Electricity Costs



Source: PT Roadmap

TARGET MARKETS

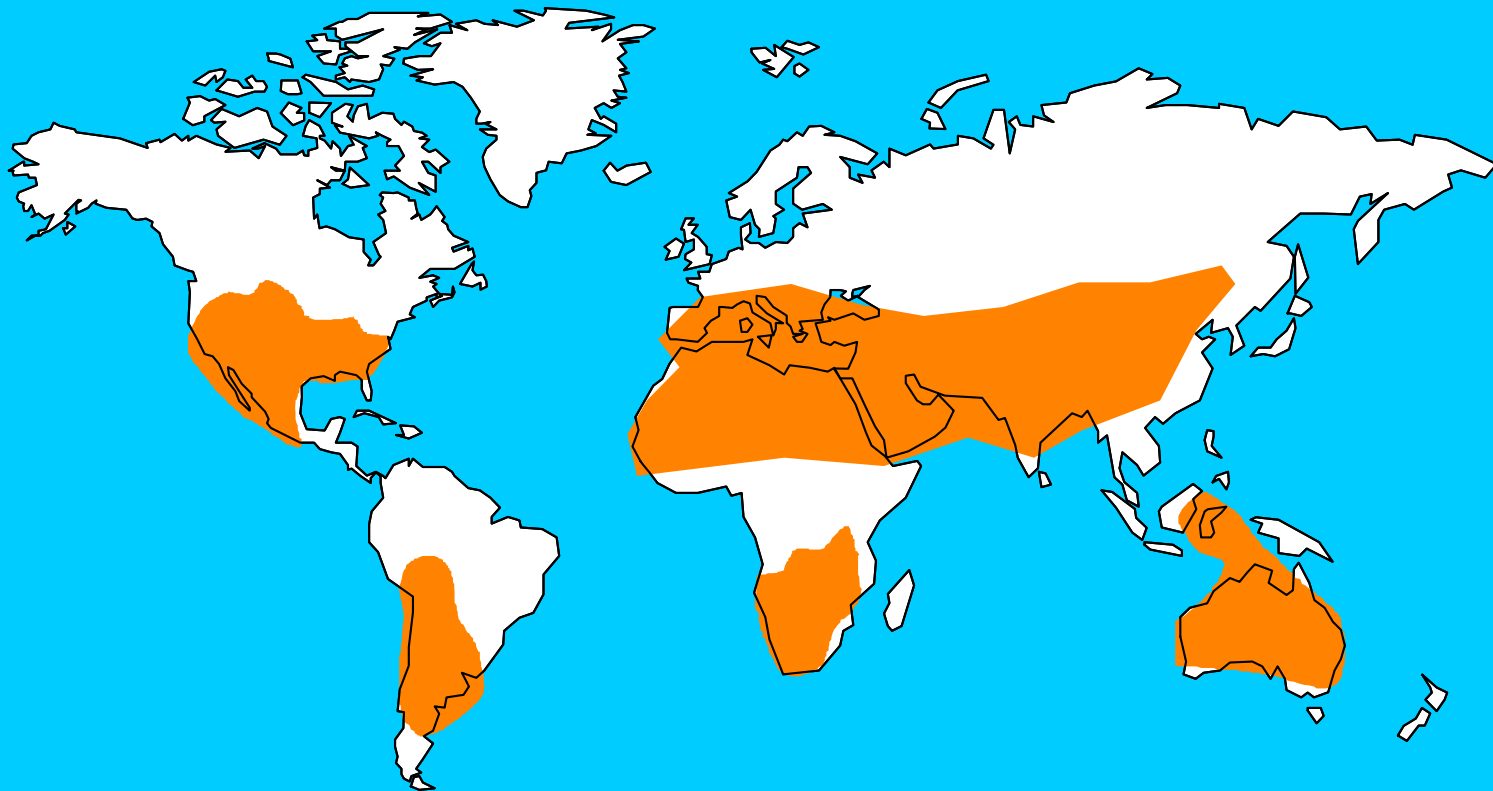
TARGET MARKETS

Many ideal markets have been identified around the world.

Ideal CSP markets require good scores for about 10 factors, such as direct normal radiation, competing energy prices, availability of subsidies, and others. Very promising markets exist in the US, Northern and Southern Africa, Middle East, Southern Europe, India, Pakistan, China, Brazil, Chile, Mexico and Australia.

Potential Solar Thermal Power Marketplace

- regions with DNI is at least 5 kWh/m²day -



Source: Solar Paces (Geyer)

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MARKET BARRIERS and POLICY TOOLS

MARKET BARRIERS

Market barriers are known, manageable and must be addressed to successfully enter commercial markets.

The major market barriers, in all countries, are higher capital costs, technical risks, financial risks; a dormant industry and cheaper competing fuels.

Additional barriers in developing countries include uncertain policies, grid extension plans, legal structure; lack of infrastructure, regressive tax policies and numerous instabilities.

POLICY TOOLS

Policies make markets – look at wind in the US and Europe, or PV in Japan and Europe. Numerous policy tools developed and used. They are an essential aspect of the commercialization path for CSP.

A variety of policies are being used today around the world to invest public funds to move RETs down the cost curve. These include RPS, SBC, NFFO, EFL, Green Pricing, Grants, low interest, production/energy/emission/tax credits, and guarantees of several kinds.

Key Factors Affecting the CSP Market

PROPELLING		HINDERING
Emission credits (green certificates)	Kyoto Flexible Mechanisms, CDM and Green Labels	Cheap fuel Higher capital cost
Savings in fuel costs	LOC to guarantee performance	Higher financial or technical risk
New capacity needs	Guaranteed long term PPAs	Dormant CSP industry
Green power choice	Investment tax credits	Regressive tax or financial policies (e.g., high import duties)
System Benefit Charges	Production tax credits	Higher transaction costs per project (1-time startup costs)
Renewable Portfolio Standards	Property tax exemption	Permitting or grid connection barriers
Restructuring	Sales tax exemption	Lack of infrastructure
Market-based prices	Low cost capital	Uncertain legal systems
Grants		Tied aid

THE CSP COMMERCIALIZATION PATH

CURRENT MARKET SITUATION IN THE US

The US is facing a need for new capacity and a need for new green capacity. As utilities compete for customers, more and more customers are choosing green power. New market forces have emerged in the power sector.

- **Restructuring**
- **Deregulation**
- **New Capacity**
- **RPS**
- **SBC**
- **Green Power**
- **Credits**
- **FEMP**
- **Cities**
- **Ownership**
- **Prices**

Conclusion – Numerous opportunities now exist for CSP in the US that can be used more towards the price take-off points. A comprehensive analysis to find optimal combinations is required.

US CSP INDUSTRY ROADMAP

- CSP, the world's Super Solar Power, is a major national and global energy resource
- It is the most cost-effective solar power generated in the world today.
- No other technology can provide full-time generation with as low emissions, and cover a range of sizes from small to large-scale generation
- Strategy involves projects (privately financed), same subsidies as other RETs, and continued highly leveraged federal R&D support

Goals

- Next 5 years – 1000 MW grid connected and 5 M sq ft of building integrated systems
- Central Station Power – 5% of 2020 needs or about 20,000 MW
- Distributed Generation – 15% of 2020 market or about 2,000 MW

What We Want

- PPAs
- Energy production and tax credits
- Low-cost finance
- Active and consistent support by DOE
- Solar Portfolio Standards

GEF COMPREHENSIVE GLOBAL MARKET INITIATIVE

- A structured global initiative is required to accelerate CSP markets by driving the cost of CSP generated electricity into the competitive range.
 - **Strategic Alliance** – the creation of a global CSP network that could lead to a strategic alliance of principal public and private stockholders.
 - **Commitments** – The operational development of the initiative would rely on explicit commitments of key stakeholders which would be defined and secured through the network and verified at an international executive level conference, bringing together the highest ranking decision makers of all interested entities.
 - **Result** – a strategic market intervention leveraging an unprecedented volume of venture capital for CSP investments through an alliance of public and private technology sponsors that would help to pull the market through aggregation and economies of scale.

Conclusion – The time is ripe to bring together the projects with the policies to drive CSP into the competitive markets.